Energy density of foods: building a case for food intake management\textsuperscript{1,2}

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The case for the energy density of foods being an important factor in regulating short-term food intake is strong (1–4). The results of classic studies of food intake in organisms ranging from blowflies to humans indicate that gastric distention plays a major role in regulating the size of a meal (5). An isocaloric meal containing foods with a low energy density causes more gastric distension than does a meal containing foods with a high energy density. However, aside from the energy density of the meal, other factors are important. These include the amount of water consumed during the meal, the palatability of the foods, the range of the energy density and fat content of the foods, and overall food intake across time periods longer than required to consume single meals. Also, the population studied (eg, obese or lean, men or women, and children or adults) may affect the import of the energy density of foods in regulating body weight. Investigators in this research area are making progress toward addressing each of these confounding issues.

Bell and Rolls (6) address several of the factors mentioned above in their article in this issue of the Journal. In their carefully conducted study, Bell and Rolls evaluated the effect of energy density on food intake and measures of hunger or fullness in lean and obese women across 3 levels of dietary fat content. The fat content and energy density of the foods reflected that found in typical American diets. Also, palatability was carefully controlled. As formerly shown by several groups (4, 7, 8), the subjects consumed less energy when foods low in energy density were included in the diet than when foods high in energy density were, at times reporting hunger or fullness ratings similar to those observed with energy-dense foods. Bell and Rolls found this even when the subjects were given foods differing in fat content (25–45\%) and energy density (5.23 and 7.32 kJ/g). Of interest was the similar effect of food energy density on total energy intake in both obese and lean women. This finding implies that obese women choose foods higher in energy density, rather than simply being resistant to the sensing of the weight or volume of foods. Regulation across long time periods might also contribute to the obese state (in the current study only 3 meals were evaluated), and obese women may consume less food in a laboratory setting than in their normal environment.

The denominator used to determine energy density can be food weight or volume, an issue not well discussed in the literature. Bell and Rolls address this topic to some degree. Weight and volume are not necessarily proportional because air is often included in foods to change the food’s texture. For example, the amount of air incorporated into frozen desserts can vary widely, from that in a dense ice cream to that in a light, whipped soft-serve ice cream. The inclusion of gas in foods may not only affect the mouthfeel and palatability of foods, but also might result in intestinal bloating because of the ingestion of air, potentially affecting food intake. Bell and Rolls noted that fat content did not affect the volume of food ingested, but did affect the weight of food ingested, emphasizing the importance of the denominator in energy density measures. The use of weight or volume intake of foods is also important in animal studies. Defined diets often include cornstarch or sucrose as a source of carbohydrates. The difference in density, ie, weight per volume, between these foods might affect experimental results, particularly over short time periods.

The availability of foods in different physical forms can change short-term intake patterns. For example, more energy can be ingested per minute when apple juice is consumed than when apples are. The recent discussion about the contribution of energy-containing soft drinks to childhood obesity also shows that easily consumed energy can affect body weight (9). These beverages can supply large amounts of energy despite their relatively low energy density (~1.7 kJ/g). This does not discount the importance of energy density, but suggests that ease of energy intake is also critical. The physical form of a food contributes to its digestibility and absorption as well (10).

Bell and Rolls show that the energy density of foods contributes to total daily energy intake. In their study, this occurred in both lean and obese women across 3 levels of dietary fat content. The continued study of the role that food energy density plays in body weight regulation is a worthwhile pursuit requiring the attention to detail paid by Bell and Rolls.

REFERENCES


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